

- 1 1. An excavator tooth useful for fracturing rock strata, comprising:
 - 2 A. a metallic core having front and rear ends and at least one
3 longitudinal surface extending between said ends;
 - 4 B. at least one projection formed from metallic stock and having a
5 tip; said projection being secured to the core at least in part by
6 welding with the tip and at least a portion of the length of the
7 projection(s) extending beyond the front end of the core; and
 - 8 C. in or on the core, at least one tooth connector portion, including
9 at least one concave or convex connector surface, of circular or
10 other configuration, positioned and adapted to engage with and
11 non-destructively disengage from at least one mating surface of
12 an excavator apparatus.
- 13 2. An excavator tooth according to claim 1 wherein the core is of circular
14 cross-section and has a single longitudinal surface in the form of a
15 cylinder.
- 16 3. An excavator tooth according to claim 1 wherein the core is of non-
17 circular cross-section and has plural longitudinal surfaces.
- 18 4. An excavator tooth according to claim 1 wherein the at least one
19 projection preferably includes at least one cut edge.
- 20 5. An excavator tooth according to claim 1 wherein the projection metallic
21 stock thickness is about 1/2 to about 3, or about 3/4 to about 2 and
22 1/4 or about 1 to about 1 and 1/2, inches.
- 23 6. An excavator tooth according to claim 1 wherein the tooth includes at
24 least one projection which has on opposite sides thereof, as viewed in
25 transverse cross-section, at least two approximately planar surfaces
26 which are approximately parallel to one another.

- 1 7. An excavator tooth according to claim 1 having at least two of said
- 2 projections thereon.
- 3 8. An excavator tooth according to claim 4 wherein two projections are
- 4 secured to substantially opposite sides of the core.
- 5 9. An excavator tooth according to claim 4 wherein at least two of said
- 6 projections have inner major surfaces, portions of which surfaces
- 7 generally face one another and extend forwardly from the core, said
- 8 portions, as they progress toward their tips, having an angle of
- 9 divergence between them of about 0 to about 30 degrees, preferably
- 10 about 2 to about 30 degrees, more preferably about 12 to about 24
- 11 degrees, still more preferably about 16 to about 20 degrees and most
- 12 preferably about 18 degrees.
- 13 10. An excavator tooth according to claim 1 wherein the metallic stock is
- 14 of abrasion resistant steel having a surface BHN (Brinell Hardness
- 15 Number) of at least about 225, preferably at least about 300, more
- 16 preferably at least about 350, more preferably at least about 375 and
- 17 still more preferably at least about 400.
- 18 11. An excavator tooth according to claim 7 which comprises iron,
- 19 carbon, manganese and silicon, and optionally but preferably at least
- 20 one additional alloying element selected from the group consisting of
- 21 chromium, nickel, boron, molybdenum, vanadium, titanium, copper,
- 22 aluminum, niobium and nitrogen.
- 23 12. An excavator tooth according to claim 8 wherein the sulfur and
- 24 phosphorous contents of the plate are respectively less than about
- 25 0.05, preferably less than about 0.04 and still more preferably less
- 26 than about 0.030 percent by weight of the entire plate stock.

- 1 13. An excavator tooth according to claim 1 wherein there is a narrowing
2 of at least one projection, between its generally longitudinal edges, in
3 the direction of the tip.
- 4 14. An excavator tooth according to claim 1 wherein first and second
5 longitudinal edges of at least one projection, or more preferably first
6 and second edges of a plurality of projections, converge with one
7 another, along at least a portion of their respective lengths, in the
8 direction of their tip or tips.
- 9 15. An excavator tooth according to claim 14 wherein such narrowing, or
10 such convergence, exists at least closely adjacent to the tip or tips.
- 11 16. An excavator tooth according to claim 14 wherein the projection
12 edges converge, as the edges approach the tips, preferably at an
13 angle of about 10 to about 35 degrees, more preferably about 15 to
14 about 30 degrees, still more preferably about 17 to about 25 degrees
15 and even more preferably about 21±2 degrees.
- 16 17. An excavator tooth according to claim 14 comprising convergence of
17 at least portions of projection longitudinal edges along substantially
18 straight lines, preferably closely adjacent to their tip or tips.
- 19 18. An excavator tooth according to claim 14 wherein convergence
20 occurs over at least about 25% and more preferably up to at least
21 about 100% of the length of the projection longitudinal edges
- 22 19. An excavator tooth according to claim 14 wherein the angles of
23 convergence between edges as the edges approach the tips is
24 generally about 10 to about 35 degrees, preferably about 15 to about
25 30 degrees, more preferably about 17 to about 25 degrees and still
26 more preferably about 21±2 degrees.
- 27 20. An excavator tooth according to claim 1 or 19 including a projection
28 with two convergent edges that are cut edges.

- 1 21. An excavator tooth according to claim 1 wherein at least one
- 2 projection is secured to the core through at least one longitudinal
- 3 surface of the core.
- 4 22. An excavator tooth according to claim 1, 7 or 21 wherein the
- 5 projection or projections is/are secured to the core entirely by welds.
- 6
- 7 23. An excavator tooth according to claim 1 comprising a plurality of said
- 8 projections that respectively extend along at least a portion of a given
- 9 longitudinal surface and are secured to the core at least in part by
- 10 welds between the given surface and adjacent portions of the
- 11 projections.
- 12 24. An excavator tooth according to claim 1 wherein the tooth connector
- 13 portion is located at the rear end of the core.
- 14 25. An excavator tooth according to claim 1 wherein the tooth connector
- 15 portion is located in or on a rearmost surface of the core.
- 16 26. An excavator tooth according to claim 1 wherein the tooth connector
- 17 portion is securely connected with a mating surface of an excavator
- 18 apparatus.
- 19 27. An excavator tooth according to claim 26 wherein the tooth connector
- 20 portion is a female member extending into the rear end of the core
- 21 and the mating surface is a male member on an excavator apparatus.
- 22 28. An excavator tooth according to claim 26 wherein the tooth connector
- 23 portion is a male member extending rearwardly from the rear end of
- 24 the core and the mating surface is a female member on an excavator
- 25 apparatus.
- 26 29. An excavator tooth according to claim 26 wherein a locking member
- 27 engaging the tooth and a portion of the excavator apparatus provides
- 28 security for the connection between the tooth connector portion and
- 29 the mating surface.

- 1 30. An excavator tooth according to claim 29 wherein the locking member
2 is a resilient insert or metallic pin.
- 3 31. An excavator tooth according to claim 26 wherein the excavator
4 apparatus is an excavating machine adapted to carry, in working
5 position, one or more teeth constructed according to the invention.
- 6 32. An excavator tooth according to claim 26 wherein the excavator
7 apparatus is an excavating machine selected from the group
8 consisting of power shovels, backhoes, draglines, dredges, graders
9 and bulldozers.
- 10 33. An excavator tooth according to claim 26 wherein the excavator
11 apparatus is a digging attachment or combination of attachments
12 adapted to be mounted on an excavating machine and to carry, in
13 working position, one or more of said teeth.
- 14 34. An excavator tooth according to claim 1 connected with a bucket
15 having a mounting pin for connecting the bucket to an excavating
16 machine, the tooth having a projection with a major surface which is
17 held in approximately perpendicular relationship with the longitudinal
18 axis of the mounting pin.
- 19 35. An excavator tooth according to claim 1 connected with a rock ripping
20 tool having a mounting pin for connecting the tool to an excavating
21 machine, the tooth having a projection with a major surface which is
22 held in approximately perpendicular relationship with the longitudinal
23 axis of the mounting pin.
- 24 36. An excavator tooth according to claim 1 connected with a bucket or
25 blade at a substantially rectilinear cutting edge of the bucket or blade,
26 said edge defining a digging axis, a major surface of the tooth being
27 held in approximately perpendicular relationship with that axis.

- 1 37. An excavator tooth according to claim 1 connected with a bucket or
- 2 blade having an at least partly non-rectilinear cutting edge having
- 3 ends at sides of the bucket or blade, said bucket or blade having a
- 4 digging axis defined by an imaginary line connecting said ends, a
- 5 major surface of the tooth being held in approximately perpendicular
- 6 relationship with that axis.
- 7 38. An excavator tooth according to claim 1 connected with a digging end
- 8 of a pivotable ripping arm for an excavating machine, said arm having
- 9 a pivoting axis about which the arm swings in operation, a major
- 10 surface of the tooth being held in approximately perpendicular
- 11 relationship with the axis.
- 12 39. A method of excavation with an excavating machine having an arm
- 13 with a pivot affording angular movement of an end of the arm about a
- 14 central axis of the pivot, said arm supporting and delivering digging
- 15 force and motion to a digging implement having projections, said
- 16 method comprising applying such force through projections that are
- 17 formed of cut plate stock and have major surfaces that are
- 18 approximately perpendicular to said axis.
- 19 40. A method of fracturing rock or frozen earth with an excavating
- 20 machine having an arm with a pivot affording angular movement of
- 21 an end of the arm about a central axis of the pivot, said arm
- 22 supporting and delivering digging force and motion to a digging
- 23 implement able to apply sufficient force through the tips of projections
- 24 on said implement to break up the strata, said method comprising
- 25 applying such force through projections that are formed of cut plate
- 26 stock and have major surfaces that are approximately perpendicular
- 27 to said axis.
- 28 41. A method according to claim 39 or 40 comprising applying such force
- 29 through one or more teeth having edges that converge at angles of
- 30 convergence between edges as the edges approach the tips of
- 31 generally about 10 to about 35 degrees, preferably about 15 to about
- 32

1 30 degrees, more preferably about 17 to about 25 degrees and still
2 more preferably about 21 ± 2 degrees.

- 3 42. A method according to claim 39 or 40 comprising applying such force
4 through one or more teeth respectively having at least two of said
5 projections with tips and inner major surfaces, portions of which
6 surfaces generally face one another and extend forwardly from the
7 core, said portions, as they progress toward their tips, having an
8 angle of divergence between them of about 0 to about 30 degrees,
9 about 2 to about 30 degrees, or about 12 to about 24 degrees, or
10 about 16 to about 20 degrees or about 18 degrees.
- 11 43. A method according to claim 39 or 40 comprising applying such force
12 through teeth wherein the plate stock is abrasion resistant steel plate
13 having a surface BHN (Brinell Hardness Number) of at least about
14 225, more preferably at least about 300, more preferably at least
15 about 350, more preferably at least about 375 and more preferably at
16 least about 400.
- 17 44. A method according to claim 39 or 40 comprising applying such force
18 through teeth which comprise iron, carbon, manganese and silicon,
19 and optionally but preferably at least one additional alloying element
20 selected from the group consisting of chromium, nickel, boron,
21 molybdenum, vanadium, titanium, copper, aluminum, niobium and
22 nitrogen.